



DEVICE FOR OPENING AND DISTRIBUTING A BUNDLE OF FILAMENTS
DURING THE PRODUCTION OF A NONWOVEN TEXTILE WEB

Technical field

The invention relates to an improvement made to the installations for making a nonwoven textile web, which is commonly referred to by the generic name of spunbond and which is formed by continuous synthetic filaments.

10 It concerns more particularly, an improvement made to ✓
the means for distributing the extruded filaments, after
drawing, over a movable transporting belt, over which they
are randomly distributed so as to form a regular web, with
a weight and thickness which can be adjusted according to
15 the applications.

Prior art

The production of nonwoven webs of the spunbond type
goes back decades and consist, generally speaking:
20 - in extruding a melted organic polymer through a
spinneret perforated with holes, so as to form a
bundle or curtain of filaments;
- then, in orienting the extruded filaments by
drawing by means of one or more fluid jet, in ✓
25 particular, compressed-air, devices, and, finally ✓
- ~~and finally~~ in receiving the bundle of filaments ✓
in the form of a web on a movable transporting
belt, which is generally subjected to a suction
source and the speed of which is adjusted
30 according to the characteristics of the web, in
particular thickness, which it is desired to
achieve.

After production, the web is consolidated, for example, ✓
35 by performing a sizing or calendering, preferably hot
calendering, so that the elementary filaments are joined to
one another.

Other consolidation treatments may be performed, where appropriate, such as, for example, a needling treatment (conventional or by fluid jets), and/or the deposition of a bonding substance on the surface or in the interior of the web.

Generally speaking, the installations used to produce such products comprise:

- at least one extruder for a melted organic polymer feeding a spinneret for producing a curtain of filaments;
- a cooling zone for bringing about at least surface solidification of the said extruded filaments;
- a suction device in the form of a narrow chamber of rectangular cross-section, inside which the curtain of filaments is subjected to the action of high-speed air streams causing the filaments to be drawn, which assembly will be referred to hereinbelow by the term "drawing slot", and
- a means for deflecting and slowing down the air flow at the outlet of the drawing slot and for distributing the filaments randomly over a receiving belt.

In such installations, the filaments emerge at the outlet of the drawing slot in the form of a bundle of filaments grouped together in the mid-plane of the said slot.

These filaments are ejected at very high speed from the ~~said~~ drawing slot, a speed which can reach 3000 m/min or more depending on the state.

In order to obtain a nonwoven web as homogeneous as possible on the receiving belt onto which the filaments leaving the drawing slot are projected, it is necessary not

only to separate the ~~said~~ filaments from one another, but
 also to slow down their speed before their impact with the
~~said~~ belt, in order to limit the uncontrollable rebound
 phenomena which generate a heterogeneous formation of the
 5 sheet.

To ensure such a break-up and distribution of the
 curtain of extruded filaments, various techniques have been
 proposed to date.

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The oldest technique, which emerges in particular from
 the patent GB-A-932,482, and from the patent
 US-A-3,967,118, consists in electrostatically charging the
 filaments, which tends to push them away from one another
 15 (corona effect).

This technology makes it possible to improve the
 formation of the sheet when the filaments are ejected at
 relatively low speed from the drawing slot, and,
 20 Consequently, ~~what are~~ ^{the so-} called the grouping-together
 phenomena of the filaments are dominant over those of the
 rebounding of the filaments on the belt.

This is the case, in particular, when the sheet consists
 25 of relatively coarse filaments, that is to say, with a count
 greater than or equal to 2.2 dtex per filament, ~~which~~ Such
 filaments are generally produced with speeds at the
 drawing-slot outlet of less than 3000 m/min.

30 In order to reduce the speed without adding an
 additional element, it is necessary in this case for the
 end of the drawing slot on which the electrostatic device
 is fixed to be situated at a relatively large distance from
 the receiving belt, of the order of 500 mm or more, ~~to~~
 35 ~~order that~~ ^{(This enables} the frictional forces of the filaments in the
 air ^{to} slow down their speed, thereby limiting the rebound
 phenomena and thus improving the formation of the sheet.

This device is not entirely satisfactory, since no control of the speed is possible and the filaments are also subjected to all the outside air currents, thereby disrupting the sheet and creating defects.

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Finally, the simple friction of the filaments in the air over such a short distance does not permit sufficient slowing-down of their speed which would enable the rebound phenomena of the filaments on the belt to be attenuated sufficiently.

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Consequently, it has been proposed, as emerges from the patent US 3,286,896, to fit to the end of the drawing slot (see Figures 7 and 8) a deflecting system to ensure a better distribution and opening of the bundles of filaments produced.

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However, since this solution does not give complete satisfaction, it has been proposed, as emerges from the patent US 3,325,906, to associate with the divergent nozzle at the drawing-slot outlet, an assembly for insufflating air on each side of this divergent nozzle, which creates a negative pressure in the vicinity of the walls, thus attracting the ^{fibers} fibres towards the walls, thereby tending to open the bundle of filaments and also slow down the speed thereof.

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Such a device, which is satisfactory in theory, nevertheless has a limited effectiveness, ^{this is true} since it is mainly the ^{fibers} fibres situated on each side of the bundle which are thus "spread", those grouped together at the ^{center} centre of the said bundle being extremely difficult to separate from one another.

35 Summary of the invention

Now, it has been found, and this forms the subject of the invention, that it was possible to achieve not only a

perfect opening of the bundle of extruded filaments at the outlet of the drawing slot, but also a very homogeneous distribution over the receiving belt. ^{This is achieved,} ~~on the one hand,~~ by separating the assembly for opening the bundle of filaments from the actual drawing slot, and on the other hand, and above all, by designing this opening assembly such that it combines both the advantages of the techniques of electrostatically charging the filaments and the techniques of opening the bundle by slowing down the air speed at the drawing-slot outlet, and thus the speed of the filaments before reception on the receiving belt. ✓

Generally speaking, the invention thus relates to a device for opening and distributing a bundle of filaments during the production of a nonwoven textile web. ^{This is achieved} ~~according~~ to the technique which consists:

- in extruding a melted organic polymer through a spinneret perforated with holes, so as to form a bundle or curtain of filaments;
- 20 - then, in orienting the extruded filaments by drawing by means of one or more fluid ~~jet~~ devices, and, ~~finally~~ ^{gradually}
- ~~and finally~~ in receiving the bundle of filaments in the form of a web on a movable transporting belt below which is arranged a suction source. ✓

The device for opening and distributing the bundle of filaments according to the invention consists of an assembly arranged downstream of the outlet of the drawing assembly and separated therefrom. ^{This assembly is} ~~comprising~~ arranged closed to the outlet of the drawing slot, a diffuser comprising an inlet zone in the form of a convergent nozzle extending over the entire width of the installation opposite the outlet of the drawing slot for producing the web, extended by a divergent nozzle. ^{The said} ~~assembly being~~ ^{is associated} ~~associated~~ with a rail ^{that} ~~electrostatically~~ ✓

Charges

~~charging~~ the filaments before they are received on the receiving belt. ✓

According to one embodiment, the divergent zone of the
 5 diffuser comprises two walls and two lateral slots situated
 at the top of the ~~said~~ diffuser, on each side thereof, and
~~permitting~~ ^{this permits} either an indraught of air from outside ~~owing~~ ^{due} to
 the venturi effect, or, where appropriate, an injection of
 air under a pressure less than one bar and advantageously
 10 between 0.4 and 0.8 bar, bringing about an air flow against
 the walls of the ~~said~~ diffuser. ✓

The above diffuser makes it possible to precisely
 adjust the width of the bundle of ~~fibres~~ ^{fibers} and also the
 15 impact speed of the filaments on the receiving belt. The
 electrostatic charging assembly being able to be situated,
 where appropriate, downstream of the diffuser assembly, but
 preferably being integrated inside the latter, thereby
 accentuating the opening of the bundle of filaments. ✓

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Advantageously and in practice:

- the diffuser comprises an inlet zone in the form
 of a convergent nozzle connected to the two walls
 of the divergent zone by a rectilinear slot, the
 25 rail electrostatically charging the filaments
 being mounted at the level of the rectilinear
 slot immediately upstream of the divergent zone;
- the distance of the diffuser from the receiving
 belt is adjustable, in order to ~~minimise~~ ^{minimize} the
 30 influence of the outside air currents on the
 bundle of ~~fibres~~ ^{fibers};
- the pressure of the air which flows in the
 diffuser against the walls thereof and the
 adjustment of the voltage applied in the
 35 electrostatic rail makes it possible to adapt
 very precisely the conditions of the formation of
 the sheet according to the speed of the filaments

at the drawing-slot outlet, thereby making particularly such a device suitable for the formation of a sheet consisting of low-denier filaments, and also for production installations working at high speed; and, *finally* ~~finally~~ the separation of the actual drawing system and that for distributing the curtain of filaments allows a possibility of adjusting the count of the said filaments without changing the appearance of the sheet and vice versa.

Brief description of the drawings

The invention and the advantages which result from it will be better understood ~~thanks to the concrete~~ *through the* exemplary embodiment which is given by way of guidance but without limitation, and which is illustrated by the attached diagrams, in which:

- Figure ^{Fig.} 1 is a general view of an installation for producing a nonwoven web of the spunbond type;
- Figure ^{Fig.} 2 is a detail view showing schematically the structure and functioning of an assembly for the opening of the bundle of filaments which is formed and its deposition on the receiving belt;
- Figure ^{Fig.} 3 illustrates a ~~variant~~ *modified* embodiment according to the invention in which the electrostatic charging of the filaments is obtained by way of a rail integrated inside the diffuser, ^{and wherein it is} ~~it being~~ possible for the flow of air inside the latter against the walls to be produced either by natural indraught of the outside air, or by a system of injection under low pressure less than one bar.

Detailed Description of the Drawings Way of carrying out the invention

Referring to the attached figures, the device according to the invention is ~~thus~~ intended for use on a

line for producing a nonwoven textile web consisting of continuous synthetic filaments.

Generally speaking, as can be seen from ~~Figure 1~~ ^{FIG.}, such an installation is ~~thus~~ composed essentially of at least one extruder, designated by the general reference ~~X1~~, which feeds synthetic polymer, such as polyamide, polyethylene, polyester, etc., to a spinneret ~~X2~~ for the formation of a curtain of filaments ~~X3~~.

From a practical point of view, by way of guidance, the spinneret consists of a plate each containing a multitude of holes, for example 5000 per ~~metre~~ ^{meter} of width and having a diameter depending on the extruded filaments, for example, of 0.5 mm. These holes are distributed over a plurality of parallel rows, for example over eighteen rows, and over a width at the spinneret outlet of 140 mm.

At the outlet of this spinneret is arranged the cooling assembly ~~X4~~ for adjusting the temperature of the filaments depending on the polymers, ~~and composed of~~ ^{and} ~~for example, of~~ a plurality of successive zones ~~X4a, 4b, 4c~~ for subjecting the curtain of filaments ~~X3~~ to traversing air flows. The speed and temperature of which may be adjusted.

By way of ~~guidance~~ ^{illustration}, the length of this ^{the} cooling zone is of the order of 1200 mm. and the temperature and speed of ~~filaments in~~ ^{the traversing air flows} each of the zones decreases from the first zone ~~X4a~~ to the third zone ~~X4c~~.

Downstream of ~~this~~ ^{the} cooling zone ^{4c} is arranged the actual drawing assembly ~~X5~~ ^{the drawing assembly 5} which is in the form of a closed enclosure having a slot ~~X6~~ into which air is injected under pressure, for example, of the order of 0.5 bar.

Such a drawing system makes it possible to bring about the suction of the curtain of filaments and its entrainment by high-speed air streams for effecting the drawing.

- 5 At the outlet of the drawing assembly ~~(5)~~, the bundle of filaments ~~(3)~~ is projected onto the receiving belt ~~(7)~~ by way of an ^{opening and distributing} assembly ~~(6)~~, ^{the} which ~~assembly~~ forms the subject of the invention, and the two embodiments of which can be seen in ^{Fig. 2} Figures 2 and 3, and ^{the assembly} which causes the air flow leaving the slot ~~(5)~~ to deviate and slow down, thus bringing about the opening of the bundle of filaments.

- 15 In the first embodiment illustrated in ^{Fig. 2} Figure 2, ^{the} such an assembly ⁶ comprises, close to the outlet of the drawing slot ~~(F)~~ of the assembly ~~(5)~~, on the one hand, a diffuser, ^{and a downstream rail 11, the diffuser 10 consists} designated by the general reference ~~(10)~~, ^{consisting} essentially of a divergent nozzle which extends over the entire width ^{the production of the web} and, on the other hand, downstream of this opening assembly, a rail ~~(11)~~ ^{arranged to} electrostatically ^{charge} the filaments at the outlet of the assembly ~~(10)~~, ^{and thereby bring} bringing about an opening at the heart of the ~~said~~ bundle of filaments before they are deposited on the receiving belt ~~(7)~~.

- 25 In this embodiment, the diffuser assembly ~~(10)~~ is composed essentially of a chamber ~~(12)~~ having an inner slot ~~(13)~~. ^{The slot 13 is} In the form of a convergent/divergent nozzle extending over the entire width of the installation opposite the outlet of the drawing slot ~~(F)~~ of the assembly ~~(5)~~.

- 30 Opening into this slot ~~(13)~~, close to the lower part of the divergent zone, are two laterally arranged symmetrical slots ~~(14)~~. These symmetrical slots ~~(14)~~ may be either connected to a source of compressed air injected under a pressure less than 1 bar and advantageously of the order of 0.4 bar, or be simply open to the outside air.

The divergent zone is, in this embodiment, extended by two walls (15) which are likewise divergent.

Arranged immediately downstream of this diffuser assembly, or where appropriate integrated inside the latter, is a conventional rail (11) for electrostatically charging the filaments, ~~thus making~~ ^{THIS makes} it possible to intensify the opening of the bundle. ~~Such a rail (11)~~ ^{the} is a conventional rail, for example of the type described in US-A-3,967,118.

^{Fig.} Figure 3 illustrates a second embodiment of ~~an~~ ^{the} assembly for opening and distributing a bundle of filaments in the form of a web produced in accordance with the invention.

In this variant, using the same references as those employed to describe the example illustrated by Figure 2, ~~the device~~ ^{assembly} for opening and distributing the bundle of filaments (6) ³ is, as before, separated from the drawing assembly (5).

This embodiment also comprises an inlet zone (13) in the form of a convergent nozzle extending opposite the outlet of the drawing slot (F). This inlet zone (13) in the form of a convergent nozzle is connected to the two walls (15) of the divergent zone by a rectilinear slot (20).

The rail (11) for electrostatically charging the filaments is, in this embodiment, integrated inside the diffuser ¹⁰ at the end of the rectilinear slot (20) immediately upstream of the divergent zone (15).

An indraught of air coming from outside owing to the venturi effect is produced through the two adjacent lateral slots formed by the ~~lower~~ ^{lower} face of the drawing assembly (5).

and the upper face of the opening and distributing assembly
167. ✓

5 An air flow thus arises along the walls (20, 15) over
the opening and distributing assembly. ✓

Where appropriate, as in the embodiment described in
conjunction with ^{Fig.} Figure 2, an injection of air under low ✓
pressure, less than 1 bar, could be produced at the two
10 lateral slots formed between the drawing assembly (5) and ✓
the opening and distributing assembly 167. ✓

It was found that with such a device not only was a
perfect opening of the bundle of filaments obtained, but
15 that, furthermore, the reception on the belt (7) was very ✓
regular and led to a very homogeneous nonwoven web being
obtained.

Of course, the invention is not limited to such an
20 embodiment, but covers any variants thereof ^{realized} realized in the ✓
same spirit.

CLAIMS

1. Device for opening and distributing a bundle of filaments during the production of a nonwoven textile web, according to the technique which consists:

- in extruding a melted organic polymer through a spinneret perforated with holes, so as to form a bundle or curtain of filaments;
- then, in orienting the extruded filaments by drawing by means of one or more fluid-jet devices (5);
- and finally, in receiving the bundle of filaments in the form of a web on a movable receiving belt below which is arranged a suction source,

characterised in that it consists of an assembly (6) arranged downstream of the outlet of the drawing assembly (5) and separated therefrom, the said assembly comprising, arranged close to the outlet of the drawing slot (F), a diffuser (10) comprising an inlet zone (13) in the form of a convergent nozzle extending over the entire width of the installation opposite the outlet of the drawing slot (F) for producing the web, extended by a divergent nozzle (15), the said assembly being associated with a rail (11) electrostatically charging the filaments before they are received on the receiving belt (7).

2. Device according to Claim 1, characterised in that the diffuser (10) comprises an inlet zone (13) in the form of a convergent nozzle connected to the two walls (15) of the divergent zone by a rectilinear slot (20), the rail (11) electrostatically charging the filaments being mounted at the level of the rectilinear slot immediately upstream of the divergent zone (15).

3. Device according to one of Claims 1 and 2, characterised in that an indraught of air owing to the venturi effect is produced between the faces opposite the

outlet of the drawing slot (5) and the inlet of the diffuser assembly (6), creating a an air flow against the walls (15) of the divergent zone.

- 5 4. Device according to Claim 3, characterised in that an injection of air under a pressure less than 1 bar is produced between the faces opposite the outlet of the drawing slot (5) and the inlet of the diffuser assembly (6).

Abstract

DEVICE FOR OPENING AND DISTRIBUTING A BUNDLE OF FILAMENTS DURING THE PRODUCTION OF A NONWOVEN TEXTILE WEB

The invention concerns a device for opening and distributing a bundle of filaments when producing a nonwoven textile web by a technique which consists in : extruding melted organic polymer through a die perforated with holes, so as to form a bundle or curtain of filaments; then directing the extruded filaments by drawing by means of one or several fluid jets ; and finally, receiving the bundle of filaments in the form of a web on a mobile conveyor belt. The invention is characterised in that it consists of an assembly arranged downstream of the outlet of the drawing assembly and separate therefrom, said assembly comprising, arranged in the proximity of the drawing slot outlet, a diffuser comprising an intake zone shaped as a convergent nozzle extending over the whole width of the installation opposite the drawing slot outlet producing the web, extended by a divergent nozzle, said assembly being associated with a ramp electrostatically charging the filaments before they are received on the receiving belt.

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